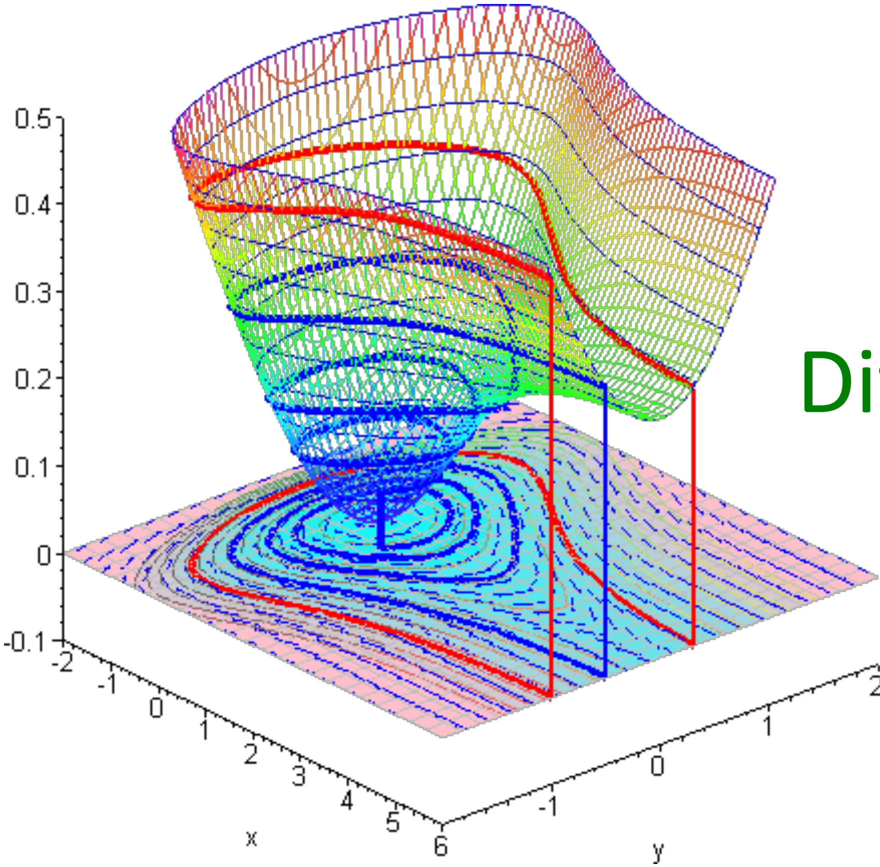
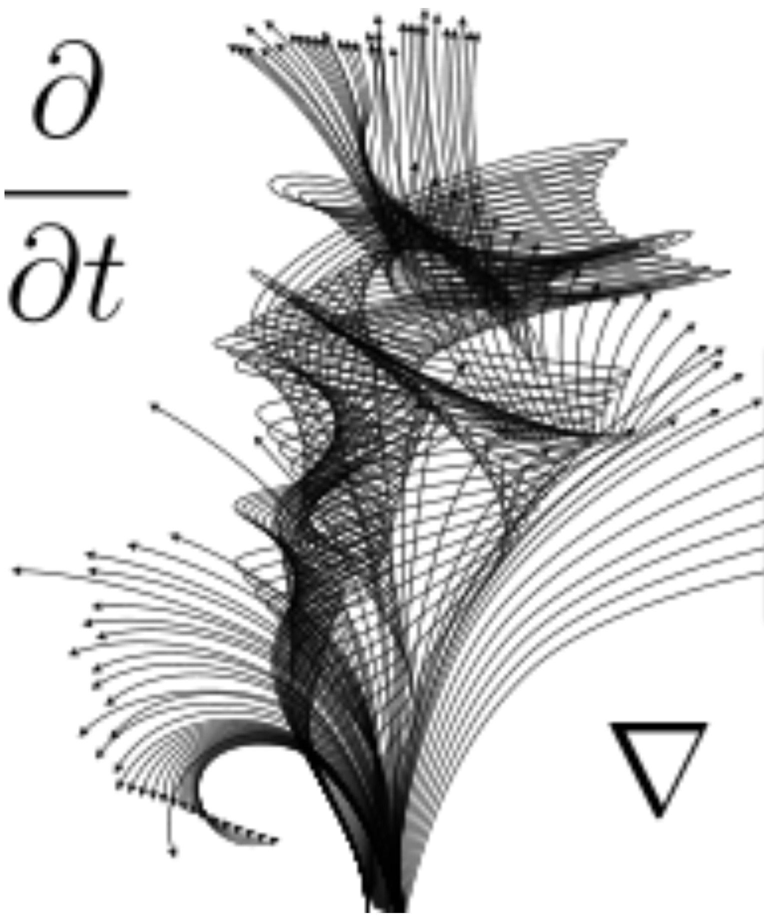


Differential Equations

Universidad de los Andes

iGEM

Express the relation between a function and its derivatives!



$$\frac{dN}{dt} = r\,N$$

Popularion growth model

$$\frac{d[C]}{dt} = \alpha_C - \gamma_C[C] - mCS\,[C][S] \quad (1)$$

$$\frac{d[C.S]}{dt} = mCS\,[S][C] - mCSQ\,[C.S][Q] - \gamma_{CS}\,[C.S] \quad (2)$$

Colombia Team iGEM 2012 equations

$$x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - \alpha^2)y = 0$$

Bessel's differential equation

The order of the equation is…

Third order ordinary differential equation

$$\dddot{x} + 85\ddot{x} + \cos(t)\, e^{x} = \sin(2t)$$

The order of the largest derivative appearing in it.

EXAMPLE: Population growth

$$\frac{dN}{dt} = r\,N$$

EXAMPLE: Population growth

Analilitcal Solution: Variable Separation …

$$\frac{dN}{dt} = r\,N \rightarrow \frac{dN}{N} = r\,dt \rightarrow \int_{N_o}^{N} \frac{dN}{N} = \int_0^t r\,dt$$

EXAMPLE: Population growth

Analilitcal Solution: Variable Separation …

$$\ln\left(\frac{N}{N_o}\right) = r\,t$$

$$\exp\left(\ln\left(\frac{N}{N_o}\right) = r\,t\right)$$

$$\frac{N}{N_o} = e^{rt}$$

EXAMPLE: Population growth

Analititcal Solution: Variable Separation ...

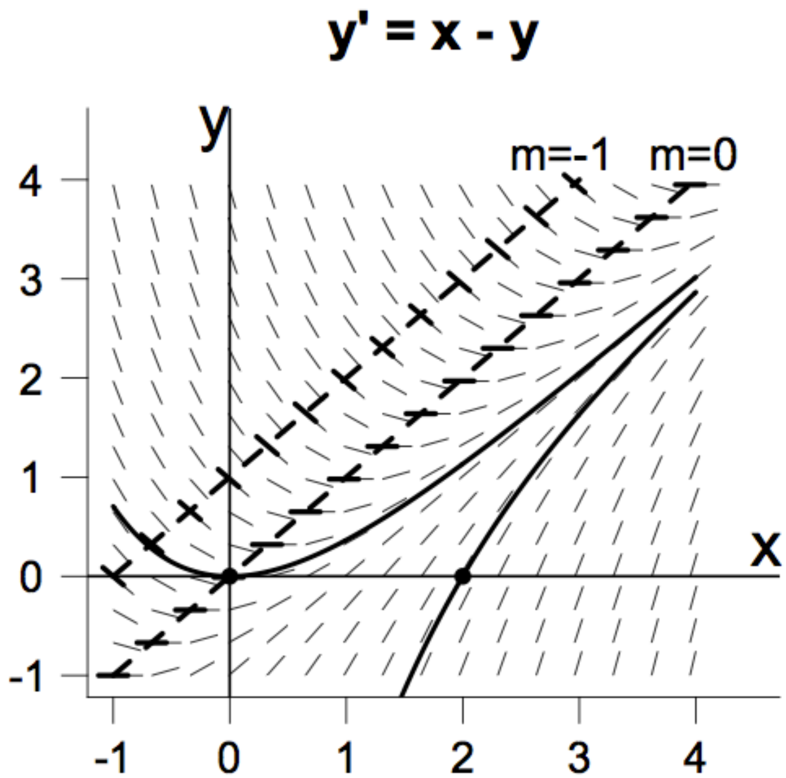
$$\frac{dN}{dt} = r\,N \longrightarrow N(t) = N_o e^{rt}$$

YOUR TURN....

$$\frac{dy}{dt} = \frac{y}{t^2}$$

Graphical Solution…

Graphical methods are based on the construction of what is called **a direction field** for the equation y’ = f (x, y)



Numerical methods

Sometimes we can’t get an answer by the analytical method and the geometrical is not enough for us. Then we have to use numerical methods..

1. **<u>Euler</u>**
2. Runge Kutta
3. Secant method
4. Bisection Method
5. Newton- Raphson method

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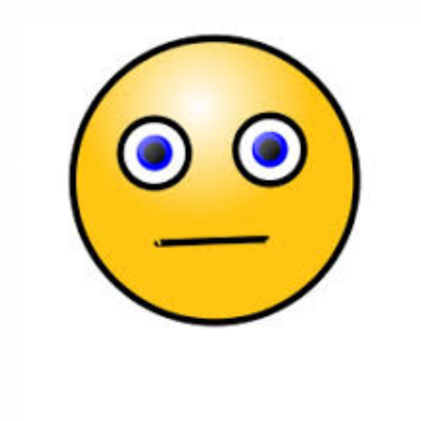

Numerical methods

$$f'(x) = \frac{f(x) - f(x + \Delta x)}{\Delta x}$$

$$f(x + \Delta x) = f(x_o) + \ f'(x_o)\Delta x$$

Numerical methods

$$f(x+\Delta x) = f(x_o) + f'(x_o)\Delta x$$